Energy Policy 87 (2015) 125–135

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Provision of electricity to African households: The importance of democracy and institutional quality

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HIGHLIGHTS

- Differences in household electricity use across African countries are studied.
- Empirical analysis is based on data from 44 countries over the period 1996–2009.
- The results display the importance of both democracy and institutional quality.
- This suggests a stronger focus on institution-building efforts in energy reforms.

ARTICLE INFO

Article history:
Received 17 April 2015
Received in revised form
1 September 2015
Accepted 1 September 2015
Available online 12 September 2015

Keywords:
Africa
Household electricity use
Democracy
Institutional quality

ABSTRACT

How can differences in per capita household electricity consumption across African countries be understood? Based on theories that highlight the importance of democracy and institutional quality for provision of public goods, the aim of the paper is to analyse the degree to which the level of per capita household electricity consumption in African countries can be attributed to the countries' democratic status and their institutional quality. We rely on regression analysis employing a pooled data set for 44 African countries over the time period 1996–2009. The analysis shows that democracy and institutional quality both have significant positive effects on per capita household consumption of electricity. Our results have implications for how energy sector reforms are promoted in developing countries. At a more general level they illustrate that institution-building policy efforts are relevant also in areas where contemporary debates have tended to primarily centre on economic development, financial prerequisites and ownership issues.

1. Introduction

1.1. Background and motivation

In this paper we address the question of why African countries differ in terms of households' ability to benefit from electricity services. Electricity is a unique energy carrier that is purposefully applied in almost all aspects of daily life among the richest segment of the world's population. It is essential for modern communications, industrial development and the build-up of public services such as streetlights, improved education and health care. Existing and future applications of electricity and other modern energy carriers will be instrumental to achieving many of the Sustainable Development Goals (SDGs) adopted in September 2015 by the member states of the United Nations. Whereas the Millennium Development Goals (MDGs) did not explicitly address the energy situation and its relation to poverty alleviation, Goal 7 among the SDGs is to "ensure access to affordable, reliable, sustainable and modern energy for all" (United Nations, 2015). The related targets promote enhanced international cooperation to facilitate energy access, and express the need to expand infrastructure and upgrade technology, especially in the least developed countries. Also, a recent report from 'Sustainable Energy for All' (SE4All) emphasizes the importance of understanding the interactions between energy and other development areas, such as food, water, gender equality, education and health, in order to achieve the objectives of the SDGs and the SE4All programme (WB and IEA, 2015).

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http://dx.doi.org/10.1016/j.enpol.2015.09.002

In many African countries, the demand for electricity generally exceeds supply (Eberhard et al., 2011). The continent is rich in unexploited energy resources, and increasing the generation and availability of electricity is a political priority in most countries. In the public debate, electricity is often portrayed as part of 'modernity' – the aspirations towards improved socioeconomic standards of living and political-economic equality (e.g., Ferguson, 2006; Winther, 2008). Evidence shows that in areas where access to electricity has been provided, there have been substantial societal benefits of long-term importance for social and economic development, including lightning, education, health, leisure and security (e.g., Davis, 1998; Karekezi and Majoro, 2002; Kirubi et al., 2009; Spalding-Fecher, 2005).

However, in spite of the above, especially sub-Saharan Africa is lagging behind the rest of the world in regard to electricity provision and use in the household sector. The countries in this region suffer both economically and socially from underdevelopment of the electric power sector, including insufficient generation capacity, unreliability of existing power supplies, poor transmission and distribution infrastructure and very low rates of access to the electricity grid (Eberhard et al., 2011; WB and IEA, 2015). In 2012, the access rate in sub-Saharan Africa was estimated at 35 per cent. During the period 2010–2012, the access expansion in this region only kept pace with population growth, and expansion mainly took place in urban areas whereas access rates actually fell in rural areas (WB and IEA, 2015). Thus, even if the African continent is rich in energy sources, technical solutions exist and increased electricity provision is much desired, this has not been enough to result in a clear increase in electricity access and higher consumption levels in the majority of African countries. There is a large literature that addresses the multitude of reasons – historical, financial, political, social and technical – behind the energy situation in various African countries (e.g., Eberhard et al., 2011; Khennas, 2012; Sokona et al., 2012). Institutional aspects have received significant attention both in terms of country-specific and regional institutional drivers and barriers to increased electricity access. The importance of "effective, accountable and inclusive institutions at all levels" is also emphasized in the SDGs Goal 16 on peaceful and inclusive societies (United Nations, 2015). We intend to complement the existing literature discussing institutional aspects (e.g. Foley, 1992; Haanyika, 2006; Karekezi and Kimani, 2002; WB, 2009) by approaching electrification in African countries as a case of public goods provision.

This implies that the benefits of providing access to affordable electricity via national grids are non-excludable and "non-rivalrous" (e.g., street lights, reliability, etc.) indicating a limited incentive for individuals or the private sector to contribute to their production (e.g., Abbott, 2001). The building of large-scale transmission and distribution infrastructure is hugely expensive and a long-term investment, thus typically of little interest to commercial investors. Rural electrification is particularly expensive in places with difficult terrain, dispersed settlement and/or low population density. For these reasons, national electric utilities have historically been reluctant to extend the electricity services to rural areas. Affordable rural electrification has in most countries been achieved through special national programmes and funding arrangements, including the use of subsidies (Zomers, 2003). Hence, the undertaking of electrifying the entire population is primarily politically driven, posing high demands on both the political and the administrative system.

Previous research suggests that democracy and institutional quality are key prerequisites for the active support of and the provision of public goods (McGuire and Olson, 1996; Deacon, 2003; Lake and Baum, 2001; Acemoglu and Robinson, 2006; Boix et al., 2003; Rothstein, 2011; Rothstein and Teorell, 2008; Schmitter and Karl, 1991). In this article, we are interested in investigating if this notion also applies to the case of electricity provision to households in Africa.

1.2. Objectives and scope

Even if electricity is provided in one sense, i.e., through the extension of the national grid, one also needs to assess whether the electricity actually becomes a "good" for the *public* in the sense that households can benefit from it. Therefore we go beyond previously studied issues, such as provision of infrastructure (as when measuring access to the grid), and even more closely, yet distant matters, such as residential share of electricity relative to industry (Brown and Mobarak, 2009). We do this by trying to capture realized *use* of electricity.

Thereby, our aim is to provide a statistical investigation of *the determinants of per capita household electricity consumption in African countries* with a particular emphasis on the impacts of democratic government and high quality institutions (e.g., rule of law and control of corruption). As will be discussed in more detail below, studying per capita household electricity consumption has several advantages over alternative indicators of provision of electricity to households, including access rates (see Section 2.2).

This article contributes to a growing literature on electrification in developing countries (e.g., Min, 2008; Nanka-Bruce, 2010; Onyeji et al., 2012). This research has pointed to a number of drivers and barriers to electrification, including oil production, economic development, population density, as well as the risk of conflict and violence. These variables are therefore also included as controls in our regression analysis. While previous quantitative studies often have had to rely on cross-sectional data, the present analysis builds on data from 44 African countries over the time period 1996–2009.

1.3. Household electrification and electricity consumption in Africa

According to Eberhard et al. (2011:53), "(i)nstalled capacity will need to grow by more than 10 per cent annually (…) just to meet Africa's suppressed demand, keep pace with projected economic growth, and provide additional capacity to support efforts to expand electrification." There are often barriers related to building and operating the infrastructure needed in both urban and rural areas, as well as barriers to electrification resulting in socio-economic development (for a review of these, see Ahlborg, 2012). Many African governments are constrained by the substantial costs involved in building large-scale electricity infrastructure and contributions from official development assistance (ODA)[1] to public investment in the electric power sector have been far below the levels needed to keep pace with economic growth and/or in order to expand public access (World Bank, 2009).

Access rates reflect the degree to which the government makes electricity infrastructure accessible to the public, but data on connection rates need to be complemented with aspects such as capacity, affordability, reliability, quality and safety (WB and IEA, 2015: 30). In 2008, the entire generation capacity of sub-Saharan countries amounted to 68 gigawatts (GW), which is no more than that of Spain, and 60 per cent out of this was installed in South Africa alone. Annual electricity generation is in turn comparatively low for a number of reasons, including aging plants, lack of maintenance, and seasonal lack of water in dams. Many countries are also dependent on imported oil and diesel, a situation that creates a vulnerability to high oil prices in the world market (World Bank, 2009).

[1] ODA is a widely used indicator of international aid flow, coined by the Organization for Economic Co-operation and Development (OECD).

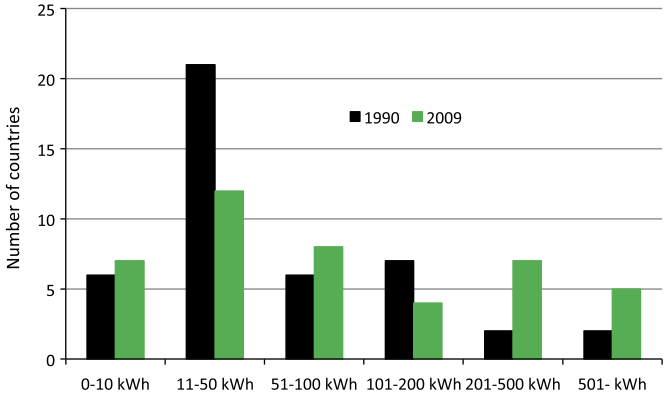

Fig. 1. Per capita household electricity consumption in African Countries, 1990 and 2009. *Source*: United Nations (2013).

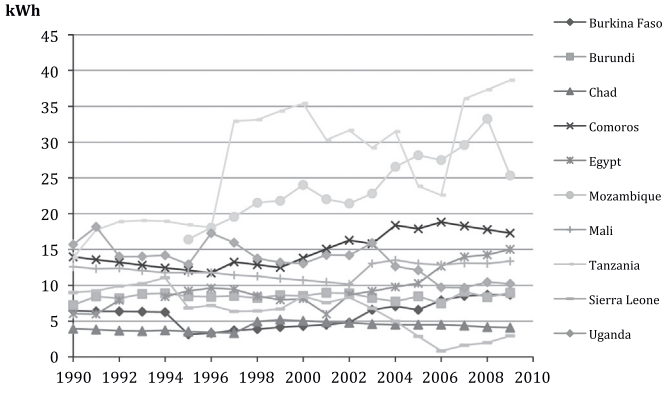

Fig. 2. Per capita household electricity consumption (kWh): Selection of ten African countries failing to provide increased household electricity access. *Source*: United Nations (2013).

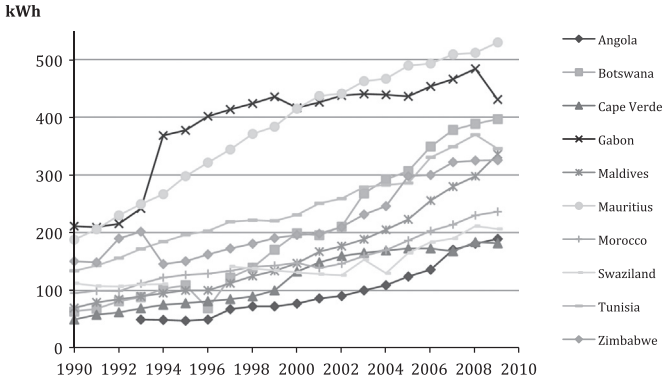

Fig. 3. Per capita household electricity consumption (kWh): Selection of ten African countries succeeding to provide increased household electricity access Source: United Nations (2013).

The lack of electricity supply manifests in low consumption levels. In 2008 the average annual per capita consumption in sub-Saharan Africa, South Africa excluded, was only 124 kWh (World Bank, 2009).[2] This estimate is, however, based on total electricity consumption in all sectors of the economy. The consumption solely by households is therefore considerably smaller. Fig. 1 displays how a set of 44 African countries can be divided into six different groups with respect to their annual per capita household electricity consumption levels, indicating also changes over the time period 1990–2009.

In many of these countries, household electricity consumption has been very low. Averaged over the whole populations – including those with no access to electricity – consumption in many cases has been lower than 50 kWh per capita. Although some countries have experienced a shift towards higher levels of electricity consumption many have also remained stagnant with virtually no growth (some even experiencing a decline over time).

Figs. 2 and 3 provide an illustration of this through a more detailed account of per capita household electricity consumption in Africa by scrutinizing a number of selected countries. Specifically, Fig. 2 shows ten examples of countries in which the per capita consumption levels have been maintained at very low levels or even decreased during the period 1990–2009, while Fig. 3 instead displays the development in ten African countries that have managed to achieve a non-negligible increase in consumption. The difference in the scale used to display per capita consumption levels (y-axis) in these two figures is profound. Overall Figs. 2 and 3, although only focusing on a selection of countries, illustrate an interesting variation across various African countries. This variation deserves further investigation.

In many African countries, electricity supply is notoriously unreliable. Low electric power quality, exemplified by blackouts and power rationing in national grids, is a common problem that incurs significant costs associated with damages to equipment and disruption of productive activities (World Bank, 2009). Aspects of capacity and quality are critical for industrial development (VPC, 2008; World Bank, 2008) but also for the development of micro and small-scale businesses, many of which are found among the household segment of electricity customers (Haselip et al., 2015). Thus, a statistical investigation of electricity provision as a case of public good provision requires that the dependent variable measures the degree to which households not only access but actually *use* electricity (which indirectly reflects the quality of supply since consumption levels are lower when access is low and supply is very unreliable).

[2] A slightly different estimate for 2008, i.e., 155 kWh per capita, is provided by Bazilian et al. (2012).

1.4. Outline of paper

The next section presents the methodological approach of the analysis. We here address the main theoretical arguments by discussing the relationship between democracy and institutional quality on the one hand and public good provision on the other. Two empirically testable hypotheses are derived. In this section our data and analytical techniques are also presented. Section 3 then outlines and discusses the results from the statistical analysis, while Section 4 discusses some important implications, not the least for policy-making. Section 5 concludes the paper and points towards some directions for future research.

2. Methods: Theoretical framework and empirical approach

2.1. The relationship between democracy, good governance and household electricity consumption

One of the central debates in research on the drivers behind public goods provision concerns what kinds of governments – democratic or autocratic – that provide public goods, such as basic infrastructure and social services, most effectively. Clearly, democratic institutions – through which the leaders of a country are held accountable to the citizens – create a strong incentive among leaders to deliver, for example, *generally demanded* public goods such as affordable electricity (Acemoglu and Robinson, 2006; Schmitter and Karl, 1991). Since elections provide citizens with the power to replace leaders that do not fulfil these expectations, and since public good provision is likely to be included in the

evaluation of political leaders, democracy can be hypothesized to lead to more public good provision (McGuire and Olson, 1996; Deacon, 2003; Lake and Baum, 2001). Moreover, generally democracy can be expected to work in the interest of the majority (i.e., the rural population) since a larger portion of the citizenry is included in the political process, whereas authoritarian regimes will frequently only see to a narrow elite (Bueno de Mequita et al., 2003; Gandhi and Przeworski, 2006). Though primarily concerned with how the share of electricity consumption differs between the residential sector and the industry sector depending on regime type, Brown and Mobarak (2009) nonetheless find certain support for this argument. At least among the poorest countries in their data set (some of which are African), democratic governments tend to increase the residential sector's share of electricity consumption relative to industry's share, thus indicating a positive relationship between democracy and provision of electricity to the *public*. Following this line of literature, the first hypothesis to be tested is

H_1. : *The more democratic a country is, the higher is per capita household electricity consumption*.

Despite strong theoretical reasons to expect a positive effect of democratic institutions on public goods provision, some scholars argue that democratic institutions are alone no guarantee for successful public good provision. The first reason is that elected leaders often work with short time horizons (Haggard, 1991; Keefer, 2006) whereas public good provision – not least in the form of investments in electric power infrastructure – is a long-term undertaking (Min, 2008). Second, the discussion on the importance of democracy has a certain Western bias. The focus on accountability and incentive structures for political leaders tend to overlook situations where political leaders wish to provide public goods but *are not able* to do so. In African countries, democratic accountability may still be crucial for political leaders' relative interest in providing public goods, but it might not be all that relevant for their capacity to do so. This was highlighted by an engineer working with rural electrification at the public utility in Tanzania (quote from interview by first author in 2010): "Political pressures you know. Like now in October it's the elections, so all the politicians are running like hell [laughing]. They want electricity, there is no money but they want the people to hear that they are struggling and working." This statement reflects that especially in times of elections, politicians may try to fulfil promises to the electorate, even in cases when necessary financial resources are not available.

Third, several studies also show how corruption and clientelistic practices (i.e., the exchange of goods and services for political support) can undermine governments' performance also in cases where democratic institutions are in place (Bratton and van de Walle, 1994, 1997; Chandra, 2004; Min, 2008). The importance of these types of factors should not be underestimated: "bad governance" – characterized for example by corruption, patronage and favouritism – has been described as a "spectre haunting democracy in the world today" (Diamond, 2007: 119).

Thus, the hypothesis on the importance of democracy must be complemented with other perspectives. In this paper we focus on the importance of institutional quality for public goods provision. With "institutions" we here refer to "the rules of the game" (e.g., North, 1990), i.e., various external factors shaping and constraining human behaviour and learning including both legal rules and informal codes of conduct (March and Olsen, 1989; Peters, 1999). Institutional characteristics that are expected to be important for public service provision include everything from the quality of the bureaucracy and the competence of civil servants, the extent to which there is effective "rule of law" (where fair and predictable rules facilitate economic and social interactions), and the presence or absence of corruption, conventionally defined as the exercise of public power for private gain (Gupta et al., 2000; Holmberg et al., 2009; Kaufmann and Kraay, 2002; Mauro, 1998; North, 1990; Nye, 1967).

On the one hand, institutions can have direct effects on public good provision (Barzel, 2002). On the other hand they can also have an indirect effect in that they influence the expectations that people have on the implementing agencies. In other words, trustworthy institutional systems, with a positive "history of play" (Acemoglu and Robinson, 2006) can be expected to positively influence the ability of agencies to provide public goods, not least through their impact on the ability to build consent regarding the collection of taxes and other contributions.

In line with this argument, the literature on rural electrification in developing countries has identified poor organizational structures and corruption as some of the barriers to successful electrification (e.g., Ahlborg and Hammar, 2014; Jones and Thompson, 1996; Karekezi and Majoro, 2002). In addition, earlier studies have shown that political interference in public electric utilities impacts negatively on their performance (Karekezi and Kimani, 2002; Zomers, 2003).

What these findings suggest is that not only are investments needed in improved generation capacity and expansion of large-scale grid infrastructure; investments in well-functioning and adequate institutional frameworks and organizations seem to be equally important prerequisites for effective electricity provision at the household level. This is well in line with a growing literature arguing that regardless of whether a country is democratic or not, the output-side of the governance system is crucial (Boix et al., 2003; Rothstein, 2011; Rothstein and Teorell, 2008). Thus, according to, for instance Rothstein (2011), the presence of corruption and poor government effectiveness explains social performance rates, and thus not the level of democracy.

Proceeding from the broad literature on the quality of institutions, the following hypothesis can be formulated:

H_2. : *The higher institutional quality a country has, the higher is the per capita household electricity consumption.*

The strong focus on the potential roles of democracy and institutional quality on the electrification of African countries represents our main contribution to the existing empirical literature. Below we explain in more detail how these analytical concepts have been operationalized in the quantitative analyses, along with the other variables used.

2.2. Statistical analysis: variable definitions and sources

2.2.1. Dependent variable

The dependent variable in our statistical analysis is annual household electricity consumption per capita (kWh per capita/year). Data over household electricity consumption come from the Energy Statistics Database provided by the United Nations Statistics Division Database (United Nations, 2013). Using a per capita measure – rather than measuring average consumption among the electrified minority – has the advantage that we can compare development patterns across countries of different population sizes. Moreover, we can also assess whether consumption levels have kept pace with population growth, a good indication of whether the government provides services of a certain quality, reaches new parts of the population, and/or whether the population with existing access increases its consumption over time.[3]

[3] It should also be noted that in our dependent variable will also account for any off-grid access to electricity using solar PV or other generation options in those

Growth in household consumption per capita should be of great interest to policy makers since such growth could indicate that the middle class of these countries has gained access to electricity of reasonable quality and price. The middle class can afford appliances and other electricity-consuming activities, why a growing middle class will result in notable increase in electricity load. Poor households that become electrified, on the other hand, tend to stay at a minimum consumption level for many years also when tariffs are low (Louw et al., 2008; van der Vleuten et al., 2007). In this paper, though, we are not able to address the often profound country heterogeneity (e.g., in terms of income disparity, rural versus urban population shares etc.), which clearly is an important issue for future research.

In order to explain the merits and limitations of our dependent variable, we now discuss it in comparison with two alternative measures that are used by other scholars as dependent variables in statistical analyses. The first one is the commonly used 'electrification rate' or 'access rate' defined as the share of population with access to electricity from national grids (regardless of the level of use). The International Energy Agency (IEA) provides data on access rates. We expect access rates and household consumption levels to be indirectly related. Notably, our use of a per capita measure is connected to access rates in the sense that it represents the consumption of the share of the population that does have access averaged over the *whole* population (including those without access). When comparing these two data sources, we find a clear positive relationship.[4]

As can be seen from Table 1, for countries with an electricity access rate between 0 and 25 per cent, 21 out of 24 countries have a per capita household consumption rate of 50 kWh or lower. Moreover, all nine countries with an electricity access share of 61 per cent or higher report a per capita consumption level higher than 50 kWh (and five of these have a consumption rate exceeding 300 kWh). Thus, although there is likely to be unresolved country heterogeneity, this at least shows that past increases in the per capita household electricity consumption have not only benefited the rich minorities.

There are several reasons why we choose to study household consumption rather than access rates. First, there are well-known reliability problems with the IEA data on access rates. The definition of access is not strictly applied; data are compiled from different sources and self-reported by countries (e.g., Doll and Pachauri, 2010; WB and IEA, 2015). It is argued that the sources of errors in the data often lead to overestimated access rates (Min, 2008). This is possibly the case also with the data on household electricity consumption, provided by the UN. We do not have sufficient information about the sources of data to know its accuracy. Still, the documented problems with reliability of data on access rates motivate us to use another type of indicator, and the consumption data from the UN is available for more countries and years than the EIA data series for access rates, which has more gaps in the data. Second, although electricity access is an important indicator of the extent to which states have entered the undertaking of providing electricity infrastructure, it usually says little about the quality and the reliability of the supply. Awaiting improved metrics on electricity access (see WB and IEA, 2015), the advantage of our dependent variable, compared to connection rates, is that it measures how access translates into real use, rather than just availability of distribution infrastructure. In case there are significant problems of reliability of supply, it should have a negative effect on the level of consumption. However, the way we have constructed our dependent variable, it adequately reflects both the reliability of supply and the access rate.

Table 1
Per capita household electricity consumption versus electricity access in 44 African countries, year 2004.

Access to electricity per capita household electricity use	0–25%	26–60%	61–100%
0–50 kWh	21	0	0
51–300 kWh	3	10	4
301 kWh or higher	0	1	5

Source: International Energy Agency (2004) and United Nations (2013).

The second alternative measure is a newly introduced one, showing the share of population in unlit areas based on analyses of satellite night time images (Doll and Pachauri, 2010; Min, 2008). This measure shows the number of people in unlit villages, defined as places that would have detectable lights if electricity were present. Apart from the methodological problems that impact the reliability of the estimates, e.g., discussed by Doll and Pachauri (2010), this method only measures stable outdoor lights, which can be a problem in African countries where supply is notoriously unreliable and load shedding is used in many areas (World Bank, 2009). Another drawback is that people without direct access living in electrified towns and villages are counted as electrified (or 'lit'). For example, people living in slums in big cities fall within the lit areas, but typically have restricted access to other equally important benefits from electricity.

2.2.2. *Independent variables*

Our two independent variables are the levels of democracy and institutional quality and we rely on existing indicators when measuring them. To capture countries' democracy level, we use the imputed Freedom House/Polity score Freedom House (Marshall and Jaggers, 2002; Teorell et al., 2011). This score is a combination of two widely used measures of democracy, the Freedom House measures for political rights and civil liberties (including the fairness of the electoral process, the right of opposition parties to take part, freedom for media and organizations, the right of assembly, etc.) and Polity IV, which focuses on electoral matters – such as elements of political competition and the role of popular participation in recruiting the executive – and the distribution of power, including constraints on the executive (for a critical discussion and comparison of the two indicators, see Hadenius and Teorell, 2005). Hadenius and Teorell (2005) show that a combination (average) of these two measures performs better in terms of validity and reliability than its constituent parts. The scale of this variable ranges from 0 to 10, where 0 denotes 'least democratic' and 10 'most democratic'. Where data on Polity is missing, data has been imputed by regressing Polity on the average Freedom House measure (Hadenius and Teorell, 2005).[5] The Quality of Government Institute provides data for this variable (Teorell et al., 2011).

For institutional quality we use a combination of the World

(*footnote continued*)
case where these systems are operated by the public utility. Non-governmental systems are not included.

[4] This cross-country comparison builds on data for the year 2004, and where we have categorized 44 African countries according to two dimensions: (a) three different groups based on their per capita household electricity consumption levels (i.e., 0–50 kWh, 51–300 kWh, and 301 kWh or higher); and (b) three groups based on their household electricity access rate (i.e., 0–25%, 26–60%, and 61–100%). This categorization results in a matrix consisting of nine groups (Table 1).

[5] Out of the countries used in our analysis, data have been imputed for the Maldives, Sao Tome and Principe, and Seychelles. We also ran sensitivity tests using country samples without the imputed data for missing observations. The results from these show that the overall conclusions of the analysis remain the same: the effect of the institutional quality index and democracy on per capita household electricity consumption are still positive and statistically significant.

Bank's Worldwide Governance Indicators *Rule of law* and *Control of corruption* (Kaufmann et al., 2009). The Worldwide Governance Indicators are based on several hundred individual variables measuring perceptions of governance, and reflecting the views of a diverse range of stakeholders. The individual measures are assigned to categories capturing six dimensions of governance: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption.[6] The scores range from –2.5 to 2.5, with higher scores corresponding to better outcomes.[7]

The dimensions that best fit with our theoretical notions about the role of good governance in provision of electricity are *Rule of Law* and *Control of Corruption. Rule of Law* includes several indicators, which measure the extent to which fair and predictable rules form the basis for economic and social interactions as well as the extent to which property rights are being protected. This includes the effectiveness and predictability of the judiciary, and the enforceability of contracts. *Control of Corruption* measures the perceptions about corruption, conventionally defined as the exercise of public power for private gain. The specific indicators range from perceptions of the frequency of "additional payments to get things done", effects of corruption on the business environment, and "grand corruption" or "state capture" (Teorell et al., 2011). Our index of "institutional quality" takes the average of these two items.[8] Observations are available from 1996, with some gaps in the series during earlier years.

The item *Government Effectiveness* – which among other indicators includes the competence of civil servants and the independence of the civil service from political pressures – is theoretically also relevant as a measure of institutional quality. The problem with this dimension of governance, however, is that it also includes perceptions of the quality of public service provision. Since such perceptions could well include provision of reliable and affordable electricity, this dimension conflates the independent and the dependent variable.

We have chosen not to include the dimension *Voice and Accountability*, which measures various aspects of the political process, civil liberties and political rights. The reason for this omission is that in our theoretical framework these aspects represent democratic qualities; they should thus be distinct from institutional quality and be measured separately (and they are included in our measure of democracy). The dimension *Political Stability*, which measures perceptions of the risk for the government being overthrown by unconstitutional or violent means (including domestic violence and terrorism) (Teorell et al., 2011), is treated as a separate control variable as it may be an important explanatory factor, but it does not belong in our theoretical definition of good governance.

2.2.3. Control variables

As indicated in Section 1, the statistical analysis includes a number of control variables. First, previous research has shown that electrification is largely dependent on economic resources (Zomers, 2001). We thus include an estimate of the countries' GDP per capita. Data come from the World Bank's World Development Indicators, and are also provided by the Quality of Government Institute (Teorell et al., 2011; World Bank, 2013a). Due to its skewed distribution, the natural logarithm of GDP per capita is used in many other studies. However, in the African context, where the economies are very small in a global comparison, it is not obvious that one should use the natural logarithm and by that also expect a diminishing "utility" of GDP per capita. Because of this, we do not employ the logarithm of GDP per capita in the main model, but we run an additional model including this variable.

Since it is, all else equal, more difficult to increase access to reliable and affordable energy when the population is spread over vast areas, we include a variable measuring population density. This measure – number of people per square kilometre of land area – is based on data from the Food and Agriculture Organization and World Bank population estimates included among the World Development Indicators (World Bank, 2013b).

When political conflicts emerge, this usually means a great challenge for the goal of electrification. In countries that have suffered from armed conflicts, the electricity infrastructure has often been seriously damaged or is out of order due to a lack of maintenance. Not only do conflicts imply a great obstacle to the normal functioning of the state. It is also common that the parties included in the conflict are trying to cut the electricity supplies of its enemies by destroying their infrastructure. We therefore include the World Bank Worldwide Governance indicator "political stability" (as previously mentioned), which combines several indicators that measure perceptions of the likelihood that the government in power will be destabilized or overthrown through unconstitutional and/or violent means, including domestic violence and terrorism (Kaufmann et al., 2009; Teorell et al., 2011).[9]

Finally, we also control for domestic oil production measured in metric tons per capita. Previous research has identified a statistically significant and positive impact of oil production on the share of the population that lives in lit areas at the global level (Min, 2008). This finding by Min (2008) contrasts with ideas put forward in the "resource curse" literature, where the argument has been made that in the absence of good democratic institutions (e.g., rule of law, lack of corruption, conflict management etc.) exploitation of natural resources could provide meagre opportunities for public benefits (Auty, 2001; Van der Ploeg, 2011). For our purposes this suggests that high oil production rates may hinder the development of competing energy sources such as electricity, including not the least investments in the public infrastructure needed to access new households. In order to address these contradictory perspectives, and the possibility that oil production could be an alternative explanation driving our results, we include oil production as a control variable. Data over crude petroleum production (in metric tons per capita) come from the Energy Statistics Database (United Nations, 2013).

2.2.4. Description of data

The statistical analyses rely on yearly country-specific observations from 44 African countries over the time period 1996–2009. The selection of countries and time-period is primarily an outcome of data availability. Our focus on the role of institutional quality does not permit an analysis of the situation prior to 1996. In addition, due to some reporting lags and frequent revisions of

[6] An unobserved components model has been used to construct six aggregate governance indicators. The governance estimates are normally distributed with a mean of zero and a standard deviation of one (1) each year of measurement. Although standardized estimates can be problematic for comparisons within countries over time, Kaufmann et al. (2006) find no systematic time trends in a selection of indicators, thus suggesting that the time-series information in the World Bank's scores can be used.

[7] The fact that the indicators are exclusively based on subjective (perceptions-based) data is a source of criticism. Still, in many instances there are no objective measures available, and/or the objective measures tend to capture *de jure* governance rather than *de facto* governance (see Kaufmann et al., 2009).

[8] In order to test whether the items are sufficiently inter-related to justify their combination in an index we calculated Cronbach's alpha. This test showed an alpha value of 0.92, thus providing a high credibility to our index.

[9] Like the other governance indicators, this variable is normally distributed with a mean of zero and a standard deviation of one (1) each year of measurement, with scores normally ranging between –2.5 and 2.5. Higher scores correspond to better outcomes.

Table 2
Descriptive statistics for dependent and independent variables[a].

Variables	Definitions	Mean	Std. dev.	Min	Max
Dependent variable					
Household electricity consumption	Annual household electricity consumption (kWh/capita)	109.009	165.795	0.830	896.128
Independent variables					
Institutional quality	Average scores of Rule of law and Control of corruption	−0.599	0.565	−2.053	0.959
Democracy	Average of Freedom House and Polity IV scores (0–10)	4.591	2.508	0.5	10
Political stability	Perceptions of risk for political instability/violence	−0.461	0.874	−2.986	1.188
Population density	People per square kilometre of land area	97.810	163.039	1.936	1039.13
Oil production per capita	Annual crude petrol production (metric tons per capita)	0.850	3.439	0	31.842
GDP per capita	GDP per capita, PPP adjusted (constant International USD)	3013.263	4301.083	247.889	31,518.5

[a] Mean estimates, standard deviations, max and min are calculated based on the countries included in the analysis over the period 1990–2009. Observations for the Institutional Quality Index and Political Stability, however, are missing until the year 1996.

observations for more recent years, we do not employ data after 2009. The countries included are listed in Appendix A. Table 2 summarizes the variables used in the quantitative analysis, and displays how each variable is defined as well as some important descriptive statistics.

2.3. Statistical estimation issues

The use of a "pooled" data set, or Time-Series Cross-Section data set, compared to a cross-sectional data set has the advantage of increasing the number of observations (and thus the degrees of freedom). Another advantage is that pooled data sets permit the inclusion of country-specific effects (which can be assumed to be fixed over time), thus avoiding bias in the estimates due to unobserved heterogeneity across countries. Still, Baltagi and Griffin (1984) suggest that if the variation between countries greatly exceeds the within variation (i.e., the variation over time), then ordinary least squares regression (OLS) with common intercepts (i.e., no country-specific fixed effects) as well as slope coefficients becomes the preferred estimator.

Finally, in reporting our results we primarily focus on the sign and the statistical significance of the estimated regression coefficients. An important reason for is that our key independent variables (e.g., institutional quality) are measured along an ordinal scale (i.e., data are shown simply in order of magnitude as there is no standard of measurement of differences). It is well-known that in such cases the estimated coefficients do not provide any meaningful information about the *magnitudes* of the respective impacts.

3. Results

The results from the panel data regression analyses are presented in Table 3, which displays the results from four different model specifications.[10] The first model is our base model, while the remaining models represent the outcomes of different types of robustness tests. In what follows, we first devote attention to the base model results and then revert to the remaining model specifications.

Table 3
Estimated regression coefficients (standard errors in parentheses).

	(1)	(2)	(3)	(4)
Institutional quality	42.67***	23.29***		
	(10.22)	(8.879)		
Democracy	3.417***	8.746***	3.000**	2.963**
	(1.263)	(1.674)	(1.249)	(1.244)
Political stability	−10.81**	−17.34***	−18.57***	−16.80***
	(5.219)	(5.323)	(6.265)	(6.062)
Population density	−0.0166	−0.0275	−0.0330*	−0.0313
	(0.0217)	(0.0212)	(0.0188)	(0.0195)
Oil production	−16.11***	−9.255***	−18.10***	−17.65***
	(4.465)	(2.336)	(4.373)	(4.241)
GDP per capita	0.0322***		0.0337***	0.0332***
	(0.00265)		(0.00243)	(0.00245)
GDP per capita (log)		136.2***		
		(10.73)		
Rule of law			47.76***	48.27***
			(10.64)	(9.173)
Control of corruption			3.498	
			(9.742)	
Constant	31.67***	−922.4***	36.99***	37.05***
	(10.36)	(76.16)	(9.859)	(10.19)
N	477	477	477	477
R^2	0.642	0.648	0.665	0.659

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

The results in our base model are well in line with our theoretical expectations; we find statistically significant positive impacts of both institutional quality and democracy on per capita household electricity consumption. These results are thus consistent with the notion that where politicians are held accountable for their decisions and where they are also able to implement large infrastructure projects, these countries are more likely to report relatively high levels of per capita household electricity consumption.

Regarding the control variables, the GDP per capita variable has the expected positive effect on per capita household electricity consumption, highlighting, for instance, the importance of funding for the huge financial undertakings that investments in electricity infrastructure and generation constitute.

Population density does not have a statistically significant effect on the per capita electricity consumption levels in the base model. This implies that it may not be population density per se, but rather the distribution of people within a country of a given

[10] Preliminary analyses revealed that one country – Libya – clearly distorted the overall relationships. This is especially true for the democracy variable: In the year 2000, Libya was the least democratic of all the countries in the sample, but simultaneously had the highest per capita household consumption of electricity. Libya has built extensive electricity infrastructure around the oil industry and is now one of the countries with the highest installed capacity on the continent and with the highest total electricity consumption in Northern Africa. In fact, Libya is an outlier not only within the full set of countries but also within the group of oil-producing countries: when Libya is excluded, oil production is negatively correlated with per capita household consumption of electricity; otherwise this is not the case. The Libyan case deserves further attention, but for the above reasons this country has been excluded from our analysis.

density, which influences household electrification patterns. In other words, future research should also address the potential impacts of urbanization rates, given that it is easier to reach the larger cities, but also how settlement patterns in rural areas affect the conditions for, and in turn are affected by, rural electrification.

We find a negative correlation between oil production per capita and per capita electricity consumption levels. This result is in opposition to previous research findings using satellite images and reporting a positive effect of oil production on the provision of electric light (Min, 2008). Our result is however consistent with the notion that, in general, the oil-producing countries in Africa have not invested their profits from oil into the provision of electricity infrastructure for the public domain (Libya being the exception).

Finally, and clearly in contradiction to our expectations, the results in the base model suggest a negative effect of political stability, basically implying that the higher the perceived likelihood that the government in power will be destabilized or overthrown by possibly unconstitutional and/or violent means, the higher is the per capita electricity consumption at the household level. It should however be mentioned that in the bivariate case, this variable displays the expected positive relationship with household electricity consumption. Excluding political stability from the analysis yields somewhat lower coefficients for the variables of interest, however the conclusions regarding statistically significant and positive effects of democracy and institutional quality remain (results not shown here). Future studies may want to consider measuring also actual outbreaks of conflict besides perceptions of the risk for such outbreaks.

Overall the results from our base model suggest that neither of our two hypotheses regarding the role of democracy and good governance, respectively, on the provision of household electricity services can be falsified. Before this can be properly concluded, however, we must test how robust these results are with respect to the use of alternative model specifications.

In model (2) we included per capita GDP in logarithmic form. As has been noted above, this is a standard measure motivated by the argument that a modest absolute impact should be assumed for this variable for countries with relatively high-income levels. Table 3 shows that at a general level, our results are robust with respect to this alternative model specification; the coefficients representing both democracy and the institutional quality index remain statistically significant and positive coefficients.

Finally on robustness tests, we also tested two different model specifications (models (3) and (4)) in which the different indicators of the institutional quality index were included separately in the regression equation. Here a general-to-specific modelling strategy (e.g., Hendry, 1995) was used, i.e., starting with both indicators and reducing the coefficients by removing the least statistically significant indicator from the model. Overall Table 3 shows that our results are overall robust with respect to these alternative model specifications. The *Rule of Law* indicator is the only statistically significant institutional variable, but given the high correlation between the different indicators (see also Section 2.2) this result should be expected.

Finally, in order to take into account the sometimes divergent development trajectories of Northern and Sub-Saharan Africa, respectively, we also ran the analysis while excluding the Northern African countries (i.e., Egypt, Libya Morocco and Tunisia) from the sample. The results from this sensitivity test are reported in Appendix B, and display that the central conclusions hold also in this specification.

4. Discussion

The existing literature on household electrification trends in low-income countries generally concludes that while the availability of funding is a necessary condition for increased electricity access, it is still not sufficient. Our analysis contributes to previous discussions of political and institutional issues (e.g., Onyeji et al., 2012) by framing public electricity provision as a case of provision of public goods and by testing the relevance of institutional theories that highlight the importance of democracy and institutional quality for service delivery in the context of household electricity consumption in Africa.

Contrary to, for instance, Rothstein (2011), we find that *both* democracy and good governance matter for public good provision and not only the latter, even though we control for per capita income (GDP) levels. The fact that both these factors have a positive effect on per capita household electricity consumption should not come as a surprise. They capture two important aspects or dimensions of policy-making: the *input* dimension, i.e., the procedures preceding decision-making and the *throughput* dimension, the latter referring to the governance structures through which official decisions are being implemented (Sharpf, 1997). The way we have conceptualized the causal link between democracy and public electricity provision, operationalized and finally measured it, we should expect that democratic institutions – i.e., competing opposition parties, free media and public participation in the recruiting of executives – lead politicians to respond to public demand for electricity services in order to be able to demonstrate results when facing future elections.

The importance of well-performing implementing organizations in the case of providing electricity can be illustrated with an example from the time period following decolonization in Africa. In many colonized countries, the national systems for the generation, transmission and distribution of electric power were built by the colonial powers in order to supply important industries and cities with fuels and electricity. At time of independence, many countries were drained of staff in government and public sector as the European colonial states left. In some countries, various political conflicts damaged the infrastructure, such as in Mozambique (Hultman, 2009). The drop in organizational capacity and the associated decrease in institutional quality that followed from the sudden loss of human capital, as well as the time lag in rebuilding those, probably had long-lasting negative impacts on state-dominated energy sectors. Thus, even if countries are scoring high on democratic indexes, the present governments most probably fall short in their ambitions and political promises unless they can be backed-up by an administrative apparatus that can ensure that the democratically founded decisions are being implemented properly.

Our results suggest that in pursuing, for instance, foreign aid policy and energy sector reform goals, an integrated approach towards household electrification is needed. Electricity access is part of broader institutional challenges in Africa requiring both well-functioning input institutions and throughput institutions, and these must be addressed and improved jointly.

As we see it, such issues have in part been neglected in the development of foreign aid as well as in the strategies employed by, e.g., the World Bank. In the 1980s up until the 1990s, the World Bank's strategy on rural electrification shifted from financial sector support towards the promotion of energy sector reforms. These reforms have primarily targeted formal institutional frameworks, economic efficiency and involvement of the private sector (Karekezi and Kimani, 2002; Nawaal Gratwick and Eberhard, 2008; Weisser, 2004; World Bank, 2008).

The emphasis on economic aspects in energy sector reform efforts has often come at the cost of social aspects (i.e., equity, public services and 'electricity for all') (e.g., Zomers, 2003).[11] But

[11] The poor management of some state-owned electric utilities in part motivated private sector involvement. Many African public utilities have been characterized by poor financial and technical performance, as well as by political interference from governments and urban elites (Karekezi and Kimani, 2002).

also, the reforms have overlooked the contextual challenges and informal aspects of implementation. For example, previous work identifies the lack of human capital, top-down organizational structures, and low salaries for staff that lead them to take jobs on the side, as well as corruption, as important barriers to effective implementation (Ahlborg and Hammar, 2014; Haanyika, 2006). Such informal and human aspects of organizational capacity and culture have been left largely unaddressed by previous reforms, which instead have, arguably, been driven by a top-down logic.

Thus, rather than making any claims that the solution to successful electrification in African countries solely lies in the presence of democratic and institutional reform, we rather argue that our findings contribute to the recognition that the provision of public goods is a complex task—electrification being no exception—and that any success is most likely dependent upon multiple factors, *including* political regime type and institutional quality. We are also aware that capturing the full complexity of the issue clearly requires additional factors, data and research methods.

On a final note, although rural electrification has hitherto been a responsibility of the state, due to the huge investments needed for building large-scale grid infrastructure, there is now an increased interest in decentralized development paths. A combination of factors – e.g., technological innovation, environmental concerns, change in political priorities and new forms of financing – has led many countries to consider an alternative, or at least a complementary, policy approach to rural electrification. Small-scale decentralized generation and distribution, e.g., making use of locally available renewable energy sources, offers a range of solutions that can meet household and community energy needs at lower cost than an expansion of the national grid. If this trend continues it may well alter the role of government policy in electricity service provision. Our understanding of the historical relationships between democratic government, institutional quality and public goods provision may therefore not be relevant for future energy systems where actors presumably may take on new roles, technical systems are configured differently and centralized governance is replaced by polycentric forms of governance (Goldthau, 2014).

5. Conclusion and policy implications

In this paper, we have addressed the overall question of what explains popular access to and use of affordable and reliable electricity in African households. Founded in theories that highlight the importance of democracy and institutional quality for public good provision, we hypothesize that these factors can help us better understand the variance in average household consumption of electricity across African countries over the time period 1996–2009. According to our findings, both qualitative input aspects (i.e., political and legal procedures) and throughput aspects of the state (regulating the behaviour of the implementing bureaucracy) contribute to explaining the observed variation in household electricity use. Specifically, the results from our statistical analyses cannot falsify our two hypotheses suggesting a positive relationship between both the presence of democratic institutions and institutional quality on the one hand and per capita household electricity consumption on the other.

This illustrates that institutional theories are relevant also in areas where contemporary debates have tended to centre on economic development, financial prerequisites and ownership issues. An important policy implication is that energy sector reform efforts in general and efforts to promote household electrification (e.g., as part of foreign aid) in particular should increasingly pay attention to important institutional constraints and capacity-building efforts. These efforts are thus not only about bringing in the necessary economic resources in terms of financing.

While our results are overall robust in terms of country sample, variable specifications, imputed values etc., the findings also generate several important questions for future research efforts. First, we have only been concerned with explaining the variation found in data over household electricity consumption. Equally important to investigate is if our findings are valid also when it comes to countries' total provision of electricity, i.e., also for industry and public institutions but also studies of the role that democracy and institutional quality play in enabling electricity access to various groups in society (e.g., income groups, urban versus rural populations etc.). Another issue for future research is to analyse how per capita consumption is distributed across different groups of households within the same country. Second, to assess whether our findings are unique for the African continent, studies of household consumption in low-income countries at other continents would be required. Third, while we show that both democracy and institutional quality appear to play significant roles in enabling household electrification Africa, it is also clear that these issues deserve further attention in future work.

There are also limitations with respect to the statistical analysis, e.g., in this paper we have implicitly assumed that democracy and institutional quality are additive and unrelated, thus implying that a given improvement in the quality of institutions will have the same effect on household electrification regardless of the level of democracy. In practice, the institutional dynamics and linkages between government, institutions and electrification are more complex and it would be useful to study these dynamics from a socio-technical systems perspective. Qualitative analysis would be helpful in order to grasp the importance of informal institutions and the 'through-put' dimension of governance. Finally, the role of states in electrifying the population is not necessarily going to remain the same in the coming decades. Entirely new forms of governance may be expected to develop with the necessary global transition to environmentally sustainable energy systems. Understanding such development will require different kinds of analyses as well as data other than national statistics on large-scale electricity provision.

Acknowledgement

An earlier version of this paper was presented at the Centre for Environmental Political Studies (CEPS) conference at Tjärnö, 29–31 May 2013. We gratefully acknowledge financial support from the two institutions that have funded the research programme of which this study is part: the Swedish International Development Cooperation Agency (SIDA) and the, providing grants of approx. 359 000 Euro and 645 000 Euro respectively during the period 2012-2014. We also appreciate valuable comments from our Political Science colleagues at Tjärnö and three anonymous reviewers. Any remaining errors, however, reside solely with the authors.

Appendix A

See Table A1.

Table A1
African countries Included in the statistical analysis.

Angola	Madagascar
Benin	Malawi
Botswana	Maldives
Burkina Faso	Mali
Burundi	Mauritania
Cameroon	Mauritius
Central African Republic	Morocco
Chad	Mozambique
Comoros	Niger
Congo	Nigeria
Congo, Democratic Republic	Rwanda
Cote d'Ivoire	Sao Tome and Principe
Djibouti	Senegal
Egypt	Seychelles
Equatorial Guinea	Sierra Leone
Eritrea	South Africa
Ethiopia	Swaziland
Gabon	Tanzania
Ghana	Togo
Guinea	Tunisia
Kenya	Uganda
Lesotho	Zambia

Appendix B

See Table B1.

Table B1
Regression model estimates when excluding Northern African countries (i.e., Egypt, Libya, Morocco, Tunisia) from the sample. Estimated regression coefficients (standard errors in parentheses).

	(1)	(2)	(3)	(4)
Institutional quality	33.93***	25.48***		
	(8.781)	(8.350)		
Democracy	6.192***	9.103***	6.080***	6.113***
	(1.541)	(1.806)	(1.531)	(1.498)
Political stability	−9.634*	−16.53***	−10.67**	−11.23**
	(4.972)	(5.135)	(5.170)	(5.276)
Population density	0.00310	−0.0236	−0.0000500	−0.00383
	(0.0232)	(0.0213)	(0.0225)	(0.0222)
Oil production	−14.33***	−8.508***	−14.53***	−15.29***
	(4.427)	(2.230)	(4.420)	(4.385)
GDP per capita	0.0306***		0.0308***	0.0313***
	(0.00281)		(0.00279)	(0.00279)
GDP per capita (log)		131.8***		
		(10.37)		
Rule of law			22.39***	31.19***
			(8.348)	(7.296)
Control of corruption			13.07	
			(9.043)	
Constant	8.982	−892.5***	10.68	8.596
	(12.01)	(74.67)	(11.58)	(11.59)
N	445	445	445	445
R^2	0.646	0.645	0.650	0.651

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

References

Abbott, M., 2001. Is the security of electricity supply a public good? Electr. J. 14 (7), 31–33.
Acemoglu, D., Robinson, J.A., 2006. Economic Origins of Dictatorship and Democracy. Cambridge University Press, New York.
Ahlborg, H., 2012. Electricity for Better Lives in Rural Tanzania and Mozambique. Understanding and Addressing the Challenges. Department of Energy and Environment, Chalmers University of Technology, Göteborg.
Ahlborg, H., Hammar, L., 2014. Drivers and barriers to rural electrification in Tanzania and Mozambique – grid-extension, off-grid, and renewable energy technologies. Renew. Energy 61, 117–124.
Auty, R.M., 2001. The political economy of resource-driven growth. Eur. Econ. Rev. 45, 839–846.
Baltagi, B.H., Griffin, J.M., 1984. Short and long-run effects in pooled models. Int. Econ. Rev. 25, 631–645.
Barzel, Y., 2002. A Theory of the State: Economic Rights, Legal Rights, and the Scope of the State. Cambridge University Press, Cambridge.
Bazilian, M., et al., 2012. Energy access scenarios to 2030 for the power sector in sub-Saharan Africa. Util. Policy 20, 1–16.
Boix, C., Adserà, A., Payne, M., 2003. Are you being served? Political accountability and quality of government. J. Law Econ. Organ. 19 (2), 445–490.
Bratton, M., van de Walle, N., 1994. Neopatrimonial regimes and political transitions in Africa. World Politics 46 (4), 453–489.
Bratton, M., van de Walle, N., 1997. Democratic Experiments in Africa: Regime Transitions in Comparative Perspective. Cambridge University Press, Cambridge.
Brown, D.S., Mobarak, A.M., 2009. The transforming power of democracy: regime type and the distribution of electricity. Am. Polit. Sci. Rev. 103, 193–214.
Bueno de Mequita, B., Smith, A., Siverson, R.M., Morrow, J.D., 2003. The Logic of Political Survival. MIT Press, Cambridge, MA.
Chandra, K., 2004. Why Ethnic Parties Succeed. Cambridge University Press, Cambridge, UK; New York, NY.
Davis, M., 1998. Rural household energy consumption: the effects of access to electricity—evidence from South Africa. Energy Policy 26 (3), 207–217.
Deacon, R., 2003. Dictatorship, Democracy and the Provision of Public Goods. Economics Working. University of California at Santa Barbara, pp. 11–99.
Diamond, L., 2007. A quarter-century of promoting democracy. J. Democr. 18, 118–120.
Doll, C., Pachauri, S., 2010. Estimating rural populations without access to electricity in developing countries through night-time light satellite imagery. Energy Policy 38, 5661–5670.
Eberhard, A., Rosnes, O., Shkaratan, M., Vennemo, H., 2011. Africa's Power Infrastructure. The World Bank, Washington, DC.
Ferguson, J., 2006. Global Shadows: Africa in the Neoliberal World Order. Duke University Press, Durham.
Foley, G., 1992. Rural electrification. The institutional dimension. Utilities Policy, 283–289.
Freedom House. ⟨http://www.freedomhouse.org⟩.
Gandhi, J., Przeworski, A., 2006. Cooperation, cooptation, and rebellion under dictatorships. Econ. Politics 18 (1), 1–26.
Goldthau, A., 2014. Rethinking the governance of energy infrastructure: scale, decentralization and polycentrism. Energy Res. Soc. Sci. 1, 134–140.
Gupta, S., Davoodi, H., Tiongson, E., 2000. Corruption and the provision of health care and education services. Working Paper. International Monetary Fund, Washington, DC.
Haanyika, C.M., 2006. Rural electrification policy and institutional linkages. Energy Policy 34 (17), 2977–2993.
Hadenius, A., Teorell, J., 2005. Assessing alternative indices of democracy, C&M Working Paper 6, IPSA, August 2005. Available at ⟨www.conceptsmethods.org/working_papers/20050812_16_PC%206%20Hadenius%20&%20Teorell.pdf⟩ (accessed 10.05.12).
Haggard, S., 1991. Inflation and stabilization. Politics and policy making in developing countries. In: Meier, Gerald M. (Ed.), Perspectives on the New Political Economy. ICS Press, San Francisco, pp. 233–249.
Haselip, J., Desgain, D., Mackenzie, G., 2015. Non-financial constraints to the establishment and scaling up of energy SMEs in Ghana, Senegal, Tanzania and Zambia. Energy Res. and Social Sci 5, 78–89.
Hendry, D.F., 1995. Dynamic Econometrics. Oxford University Press, Oxford.
Holmberg, S., Rothstein, B., Nasiritousi, N., 2009. Quality of government: what you get. Annu. Rev. Polit. Sci. 12, 135–161.
Hultman, L., 2009. The power to hurt in civil war: the strategic aim of RENAMO violence. J. South Afr. Stud. 35 (4), 821–834.
International Energy Agency (IEA), 2004. World Energy Outlook. OECD, Paris.
Jones, G.J., Thompson, G., 1996. Renewable energy for African development. Sol. Energy 58 (1–3), 103–109.
Karekezi, S., Kimani, J., 2002. Status of power sector reform in Africa: impact on the poor. Energy Policy 30 (11–12), 923–945.
Karekezi, S., Majoro, L., 2002. Improving modern energy services for Africa's urban poor. Energy Policy 30 (11–12), 1015–1028.
Kaufmann, D., Kraay, A., 2002. Growth Without Governance. World Bank Policy Research Working Paper no. 2928 (November), Washington, DC.
Kaufmann, D., Kraay, A., Mastruzzi, M., 2006. Governance Matters V: Aggregate and Individual Governance Indicators for 1996–2005. The World Bank.
Kaufmann, D., Kraay, A., Mastruzzi, M., 2009. Governance Matters VIII: Aggregate and Individual Governance Indicators for 1996–2008. World Bank Policy Research Paper No. 4978.
Keefer, P., 2006. Clientelism, credibility and the policy choices of young democracies. Am. J. Polit. Sci. 51 (October), 804–821.
Khennas, S., 2012. Understanding the political economy and key drivers of energy access in addressing national energy access priorities and policies: African

perspective. Energy Policy 47 (Suppl. 1), S21–S26.
Kirubi, C., Jacobson, A., Kammen, D.M., Mills, A., 2009. Community-based electric micro-grids can contribute to rural development: evidence from Kenya. World Dev. 37 (7), 1208–1221.
Lake, D.A., Baum, M., 2001. The invisible hand of democracy: political control and the provision of public services. Comp. Polit. Stud. 34 (6), 587–621.
Louw, K., Conradie, B., Howells, M., Dekenah, M., 2008. Determinants of electricity demand for newly electrified low-income African households. Energy Policy 36 (8), 2812–2818.
March, J.G., Olsen, J.P., 1989. Rediscovering Institutions: the Organizational Basis of Politics. Free Press, New York.
Marshall, M.G., Jaggers, K., 2002. Polity IV Project: Political Regime Characteristics and Transitions, 1800–2002: Dataset Users' Manual. University of Maryland, Maryland.
Mauro, P., 1998. Corruption and composition of government expenditure. J. Public Econ. 69, 263–279.
McGuire, M.C., Olson, M., 1996. The economics of autocracy and majority rule: the invisible hand and the use of force. J. Econ. Lit. 34 (1), 72–96.
Min, B., 2008. Democracy and Light: electoral accountability and the provision of public goods. Working paper.
Nanka-Bruce, O., 2010. The Socio Economic Drivers of Rural Electrification in Sub-Saharan Africa, Surrey Energy Economics Discussion Paper Series 128. Surrey Energy Economics Centre, University of Surrey, UK.
Nawaal Gratwick, K., Eberhard, A., 2008. An analysis of independent power projects in Africa: understanding development and investment outcomes. Dev. Policy Rev. 26 (3), 309–338.
North, D., 1990. Institutions, Institutional Change and Economic Performance. Cambridge University Press, Cambridge.
Nye, J.S., 1967. Corruption and political development: a cost–benefit analysis. Am. Polit. Sci. Rev. 61, 417–427.
Onyeji, I., Bazilian, M., Nussbaumer, P., 2012. Contextualizing electricity access in sub-Saharan Africa. Energy Sust. Dev. 16, 520–527.
Peters, B.G., 1999. Institutional Theory in Political Science. The 'New Institutionalism'. Continuum, London, New York.
Rothstein, B., 2011. The Quality of Government: Corruption, Social Trust and Inequality in International Perspective. University of Chicago Press, Chicago.
Rothstein, B., Teorell, J., 2008. What is quality of government: a theory of impartial political institutions. Governance 21 (2), 165–190.
Schmitter, P.C., Karl, T.L., 1991. What democracy is… and is not. J. Dem. 2 (3), 75–88.
Sharpf, F.W., 1997. Games Real Actors Play: Actor-centered Institutionalism in Policy Research. Westview Press, Boulder.
Sokona, Y., Mulugetta, Y., Gujba, H., 2012. Widening energy access in Africa: towards energy transition. Energy Policy 47 (Suppl. 1), S3–S10.
Spalding-Fecher, R., 2005. Health benefits of electrification in developing countries: a quantitative assessment in South Africa. Energy Sust. Dev. 9 (1), 53–62.
Teorell, J., Samanni, M., Holmberg, S., Rothstein, B., 2011. The QoG Standard Dataset version 6Apr11, University of Gothenburg: The Quality of Government Institute. ⟨http://www.qog.pol.gu.se⟩.
United Nations, 2013. Energy Statistics Database. United Nations Statistic Division (downloaded May 2013)⟨http://data.un.org/⟩.
United Nations, 2015. Sustainable development goals. ⟨http://www.un.org/sustainabledevelopment/sustainable-development-goals/⟩ (accessed 20.08.15).
Van der Ploeg, F., 2011. Natural resources: curse or blessing? J. Econ. Lit. 49 (2), 366–420.
van der Vleuten, F., Stam, N., van der Plas, R., 2007. Putting solar home system programmes into perspective: what lessons are relevant? Energy Policy 35 (3), 1439–1451.
VPC, 2008. Productive Uses of Energy. Vattenfall Power Consultant, Maputo.
Weisser, D., 2004. Power sector reform in small island developing states: what role for renewable energy technologies? Renew. Sust. Energy Rev. 8 (2), 101–102.
Winther, T., 2008. The Impact of Electricity. Development, Desires and Dilemmas,. Berghahn Books, New York.
World Bank, 2008. The Welfare Impact of Rural Electrification: A Reassessment of the Cost and Benefits. World Bank Independent Evaluation Group, Washington, DC.
World Bank, 2009. Underpowered: The State of the Power Sector in Sub-Saharan Africa. Africa Infrastructure Country Diagnosis. Background paper 6. The World Bank, Washington.
World Bank, 2013a. World Development Indicators. ⟨http://data.worldbank.org/data-catalog/world-development-indicators⟩.
World Bank, 2013b. World Development Indicators. ⟨http://data.worldbank.org/data-catalog/world-development-indicators⟩ (downloaded May 2013).
WB and IEA, 2015. Sustainable Energy for All 2015: Progress Toward Sustainable Energy. World Bank, Washington, DC.
Zomers, A., 2001. Rural Electrification. Utilities' Chafe or Challenge?. Twente University Press, Enchede.
Zomers, A., 2003. The challenge of rural electrification. Energy Sust. Dev. 7 (1), 69–76.